Length of Run

The length of run must not only include the actual linear feet of straight pipe, but also the proper allowance for fittings, valves friction and other items which cause drop in pressure.

Pressure Drop

There are, theoretically, several factors to be considered, including: the initial pressure, the pressure required at the end of the line, fluctuations in the initial pressure, the distance between the bottom of low point of steam main and dry return and the water line of the boiler (where the condensation is to be returned by gravity), the extra load on the system during heating-up periods, and the critical velocity of the steam (especially in risers and branches where the steam and condensate flow in opposite directions), and in other lines where high velocities are objectionable from the standpoint of noise, or the entrainment of condensate.

With a high initial pressure it is theoretically possible to allow much greater drops in pressure if there is sufficient distance between the low point of steam main and dry return and the water line of the boiler. In attempting any very great drop in pressure, the following practical difficulties present themselves:

1. If the system is designed to secure the same drop in pressure for each unit of radiation (including those nearest, as well as those farthest from the source of supply) the velocity necessary to equalize these drops in the shorter runs will be so high that serious trouble will be encountered from noise and the entrainment of the condensate.

2. If the system is so designed as not to equalize these pressures, the condensate returning from radiators near the source of supply will be at a correspondingly higher temperature than that from radiators farthest from the source of supply, thus causing re-evaporation and pressures in the return system with consequent backing-up from one radiator to another, the holding-up of the return and the filling of the return lines, with too large a percentage of steam instead of condensate.

It has been found, that while it may be theoretically possible to design a system for reatively large pressure drops, it is generally more satisfactory to design heating systems on the basis of a low initial pressure and reasonably low total drops in pressure. The matter of fluctuations in pressure should be taken into consideration wherever the steam is to be supplied directly from the boiler, to the radiators at boiler pressure and the system should be designed to operate properly with the lowest pressure under which the boiler may operate.

With reasonably free venting, the steam supply requirements during the heating-up period may run as high as 300 per cent of the normal maximum load under running conditions (see p. 49, Fig. 9). Allowances should be made for this extra demand, but inasmuch as the steam supply and the demand are somewhat self-regulating, so that if the demand is greater than the supply the pressure will drop and the supply be automatically reduced, the allowance generally made is considerably under 300 per cent. It is more economical to allow for a certain amount of overloading of the system during the heating-up periods and to allow a little more time for heating up than would otherwise be required.

In the matter of initial pressure and return conditions it is undoubtedly true that with a constant initial pressure (such as is produced by a high pressure supply by means of a pressure reducing valve, or from the boiler direct where the pressure is maintained constant), somewhat higher drops in pressure and correspondingly smaller pipe may be successfully used. It is also undoubtedly true that, with a mechanical return line system where a constant vacuum of any desired degree of from 5 to 15 in. of mercury may be maintained, the factor of fluctuations in initial pressure and the difficulties from high velocities and re-evaporation are reduced, so that the pressure drops may also be higher and the pipe sizes smaller.

Unusual Conditions

Under this heading are the character and class of the building, the periodicity of use and the degree of normal temperature to be attained at the beginning of each period of use.

In public buildings, schools, offices, places of assemblage, and such buildings (where the occupants are normally at rest) the building should be heated to its normal temperature at the beginning of each period of use. In some buildings (especially offices, schools and public buildings), the time between heating periods is relatively short; whereas, in others (such as churches, places of assemblage, etc.), these periods are comparatively long. In commercial buildings such as factories, warehouses, etc., where the occupants are normally exercising, it is not necessary for the building to be heated to normal temperature at the beginning of its period of use. These facts should be taken into consideration in the matters of allowances which are to be made in the capacity of the system.

GENERAL DATA ON PIPE SIZE TABLES

The following pipe size tables have been compiled for use in designing steam heating systems, and may be used, by those experienced in the profession, with satisfactory results. The following general principals should be followed:

1. The initial pressure should not exceed 16 oz. gage.

2. It is recommended that the drop in pressure in the mains and riser to the farthest radiator should not exceed 1 oz. per 100 ft. of straight pipe or its equivalent length, with a lower rate of drop for systems with long runs.

3. In small installations, such as residences, where the longest actual run is seldom over 200 ft., and where the firing periods extend over several hours, resulting in boiler pressure, fluctuating from zero to about 1 lb., the total pressure drop should not exceed 2 oz. In larger buildings, where boilers are under the constant care of a fireman, a uniform boiler pressure is maintained, and where the water line difference will permit, the total drop in pressure may range from 2 to 8 oz., depending upon the equivalent length of the longest run. The total drop in pressure between the boiler and the farthest radiator, even in a skyscraper, should not exceed 8 oz.

4. The total allowable drop in pressure depends upon (*a*) the water line difference, (*b*) the equivalent length of main and riser from the boiler to the farthest radiator, and (*c*) the regularity of the pressure maintained at the boiler or source of steam supply.